Naval Research Laboratory
Washington, DC 20375-5320

NRL/MR/6180--04-8732

Mock Weapon Magazine Outfitting Aboard ex-USS *Shadwell* to Support LFT&E Program for CVNX (LSD-15)

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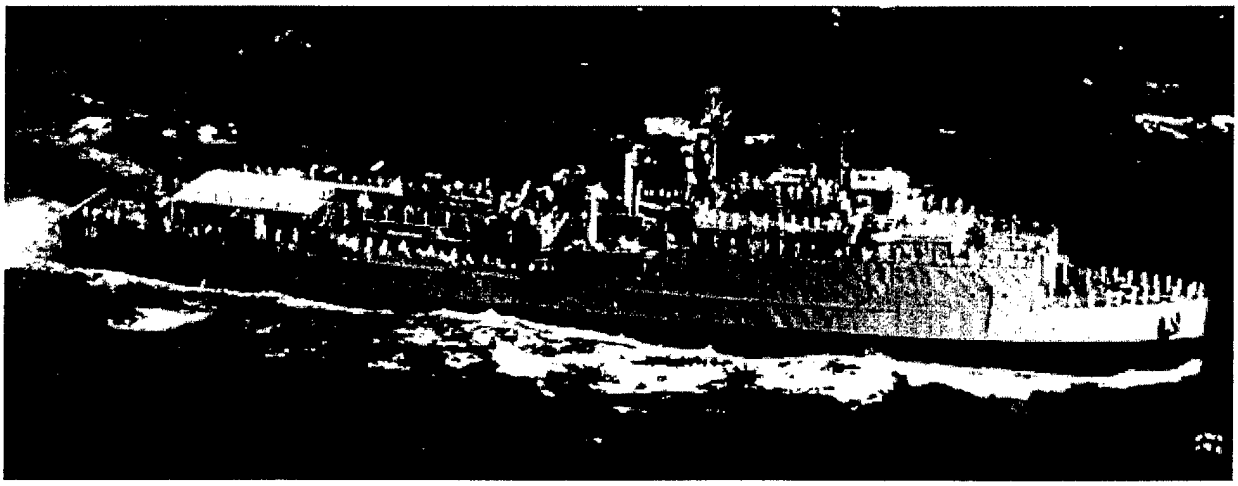
January 12, 2004



REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
January 12, 2004	Memorandum Report	January 2003 to May 2003

4. TITLE AND SUBTITLE

Mock Weapon Magazine Outfitting Aboard ex-USS *Shadwell* to Support LFT&E Program for CVNX (LSD-15)

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

S.N. Fowler,* B.J. Havlovick,* J.T. Yadon, and F.W. Williams

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Naval Research Laboratory, Code 6180
4555 Overlook Avenue, SW
Washington, DC 20375-5320

8. PERFORMING ORGANIZATION REPORT NUMBER

NRL/MR/6180--04-8732

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Naval Sea Systems Command
1333 Isaac Hull Avenue, SE
Washington Navy Yard, DC 20376

10. SPONSOR / MONITOR'S ACRONYM(S)

11. SPONSOR / MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

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14. ABSTRACT

The objective of this report is to present the basic physical characteristics of the two mock weapon magazines aboard the ex-USS *Shadwell*. In addition, details on the structural, mechanical, and electrical mock systems are provided to document the outfitting that will be implemented. Those aspects of the mock weapon magazines aboard the ex-USS *Shadwell* that are presented are spatial data, structural, insulation, ventilation, fire protection, drainage, magazine stowage, and electrical.

15. SUBJECT TERMS

Magazine; Outfitting

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Frederick W. Williams
Unclassified	Unclassified	Unclassified	UL	32	19b. TELEPHONE NUMBER *(include area code)* 202-767-2476

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

CONTENTS

NOMENCLATURE

ACH	Air Changes per Hour
ASTM	American Society for Testing and Materials
BHD	Bulkhead
CVN	Carrier Vessel Nuclear
CVNX	Future Aircraft Carrier
FR	Frame
FWD	Forward
GPM	Gallons per Minute
HSD	Heat Sensing Device
LFT&E	Live Fire Test and Evaluation
LPM	Liters per Minute
NRL	Naval Research Laboratory
NSWC	Naval Surface Warfare Center
PRP	Pneumatic Released Pilot
PSI	Pounds Per Square Inch
STBD	Starboard

MOCK WEAPON MAGAZINE OUTFITTING ABOARD EX-USS *SHADWELL* TO SUPPORT LFT&E PROGRAM FOR CVNX (LSD-15)

1.0 INTRODUCTION

Ongoing survivability analysis on the proposed CVNX design will identify strengths and weaknesses in terms of damage and damage control. These assessments, motivated by Live Fire Test and Evaluation (LFT&E) requirements, currently use a combination of analytical techniques, test data, and engineering judgment. It is anticipated that these analyses will identify specific scenarios and designs that require further qualification. From a preliminary standpoint, scenarios involving aircraft carrier magazines and the hangar spaces have been identified as requiring baseline damage/damage control assessment. To perform these baseline assessments, a suitable test platform is required. The ex-USS SHADWELL [1] has been selected for use to establish survivability features of the CVNX designs.

The objective of this report is to present the basic physical characteristics of the two mock weapon magazines aboard ex-USS SHADWELL. In addition, details on the structural, mechanical, and electrical mock systems are provided to document the outfitting that will be implemented.

Those aspects of the mock weapon magazines aboard ex-USS SHADWELL that are presented could be categorized as follows:

1. Spatial Data
2. Structural
3. Insulation
4. Ventilation
5. Fire Protection
6. Drainage
7. Magazine Stowage, and
8. Electrical

Manuscript approved August 19, 2003.

2.0 SPATIAL DATA

At the onset of this program to assess survivability of proposed CVNX magazine designs, two spaces aboard ex-SHADWELL were selected to serve as mock weapon magazines. The smaller one was designated as Weapon Magazine 2-22-2-M and is portrayed in a plan view by Figure 1. In association with Figure 1, two elevation views are shown in Figure 2.

The second mock space was designated as Weapon Magazine 3-24-0-M and resides partially below the smaller mock weapon magazine. This second mock magazine is shown in plan view by Figure 3. Two elevation views from the exterior of the magazine are shown in Figure 4.

The gross volume for the small magazine is equal to 64.8 m^3 (2,290 ft^3) and is derived from the dimensions documented in Table 1.

Table 1. Dimensions of Weapon Magazine 2-22-2-M

Parameter	Dimension
Length	6.1 m (20 ft 0 in)
Width	3.6 m (11 ft 10 in)
Height	3.0 m (10 ft 0 in) FR27 Port 3.0 m (9 ft 8 1/2 in) FR27 STBD 3.0 m (9 ft 7 in) FR22 Port 2.9 m (9 ft 5 in) FR22 STBD 3.0 m (9 ft 8 in) Average
Volume	64.8 m^3 (2,290 ft^3)

The small magazine is bordered by five different test compartments aboard ex-SHADWELL. Those are:

Test Space 2-20-2-Q (FWD)

Combat Information Center 2-18-0-C (FWD)

Operation Office 2-22-1-Q (STBD)

Combat Systems Office 2-23-2-Q (Port & AFT)

Access Trunk 4-22-2-T (Port)

See Figure 1.

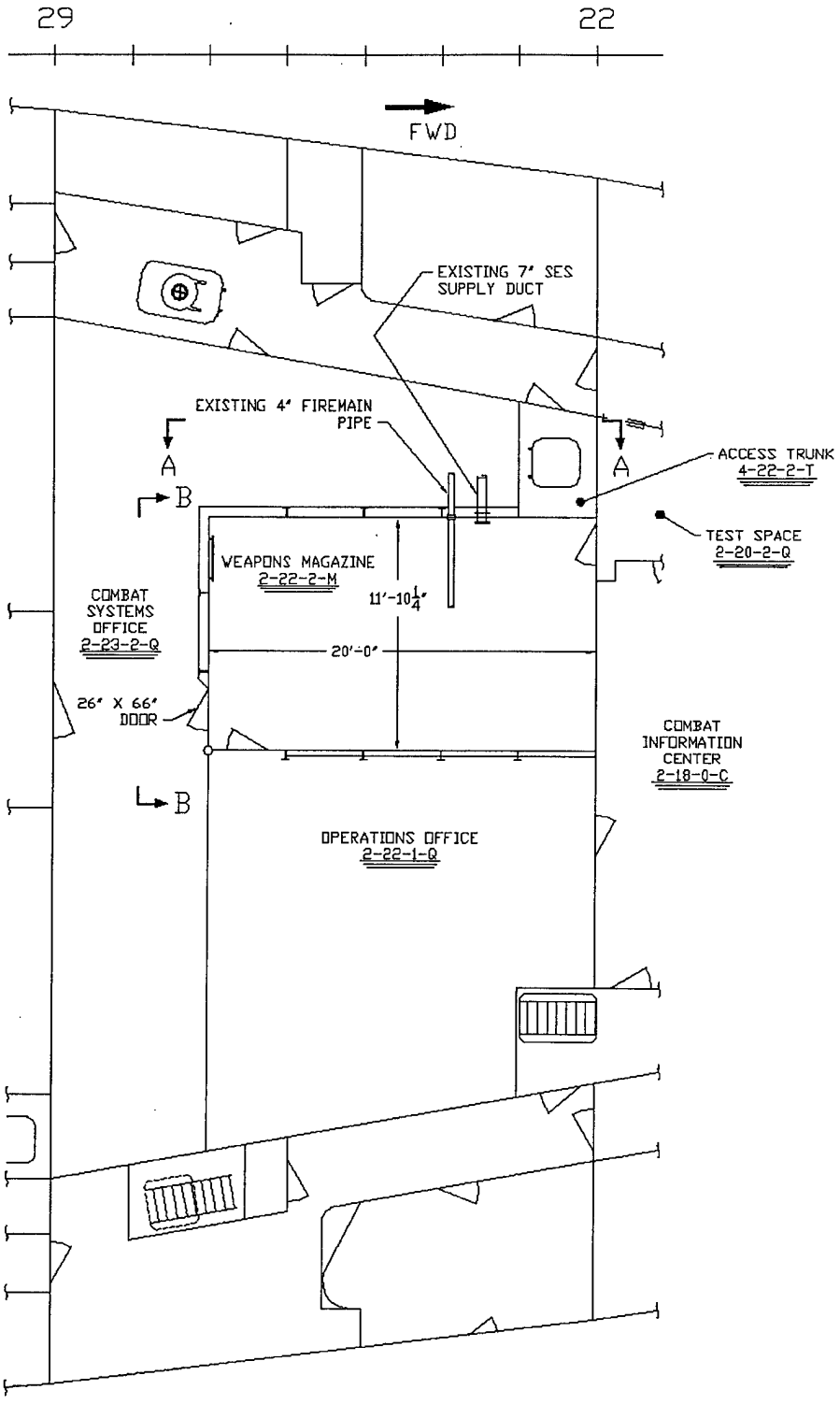

Figure 1. Weapon Magazine 2-22-2-M on 2nd Deck

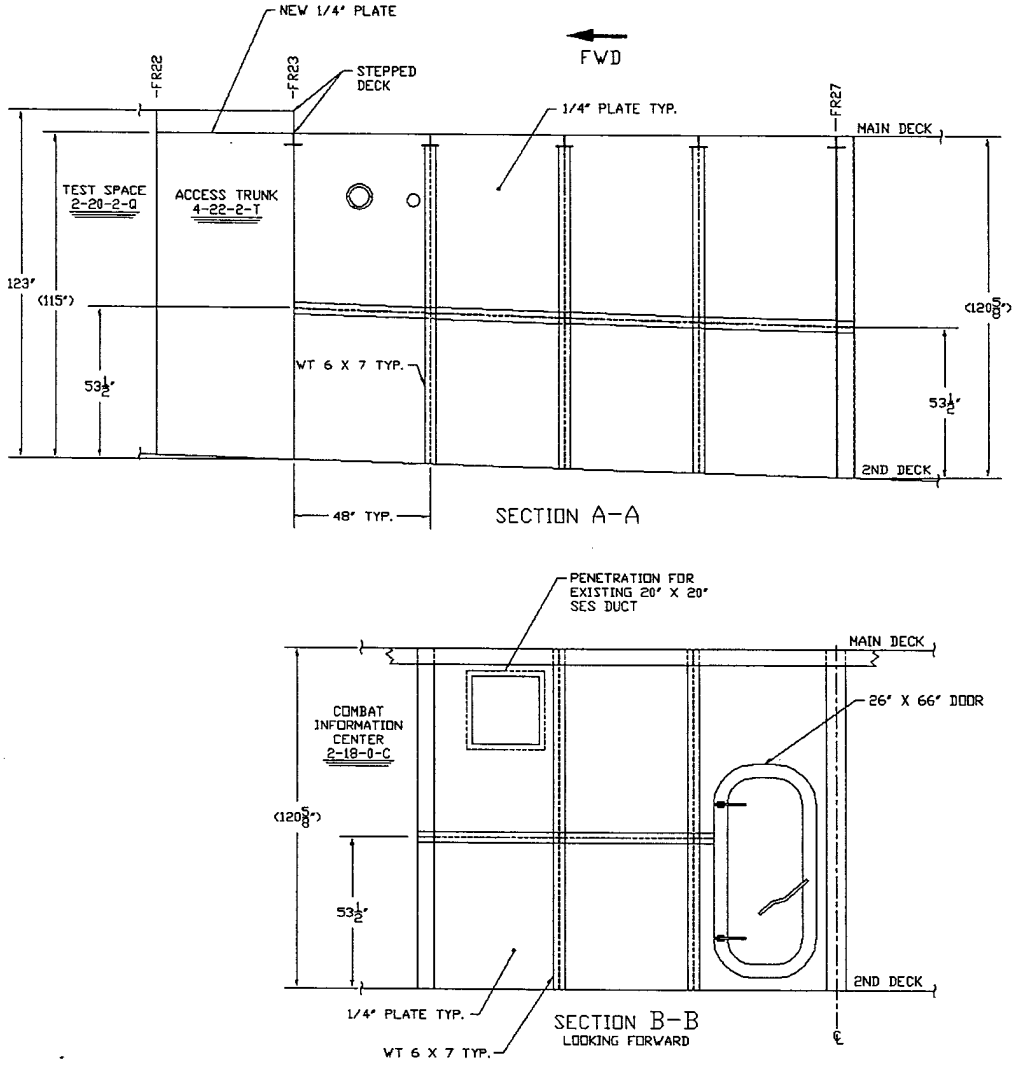

Figure 2. Weapon Magazine 2-22-2-M Exterior

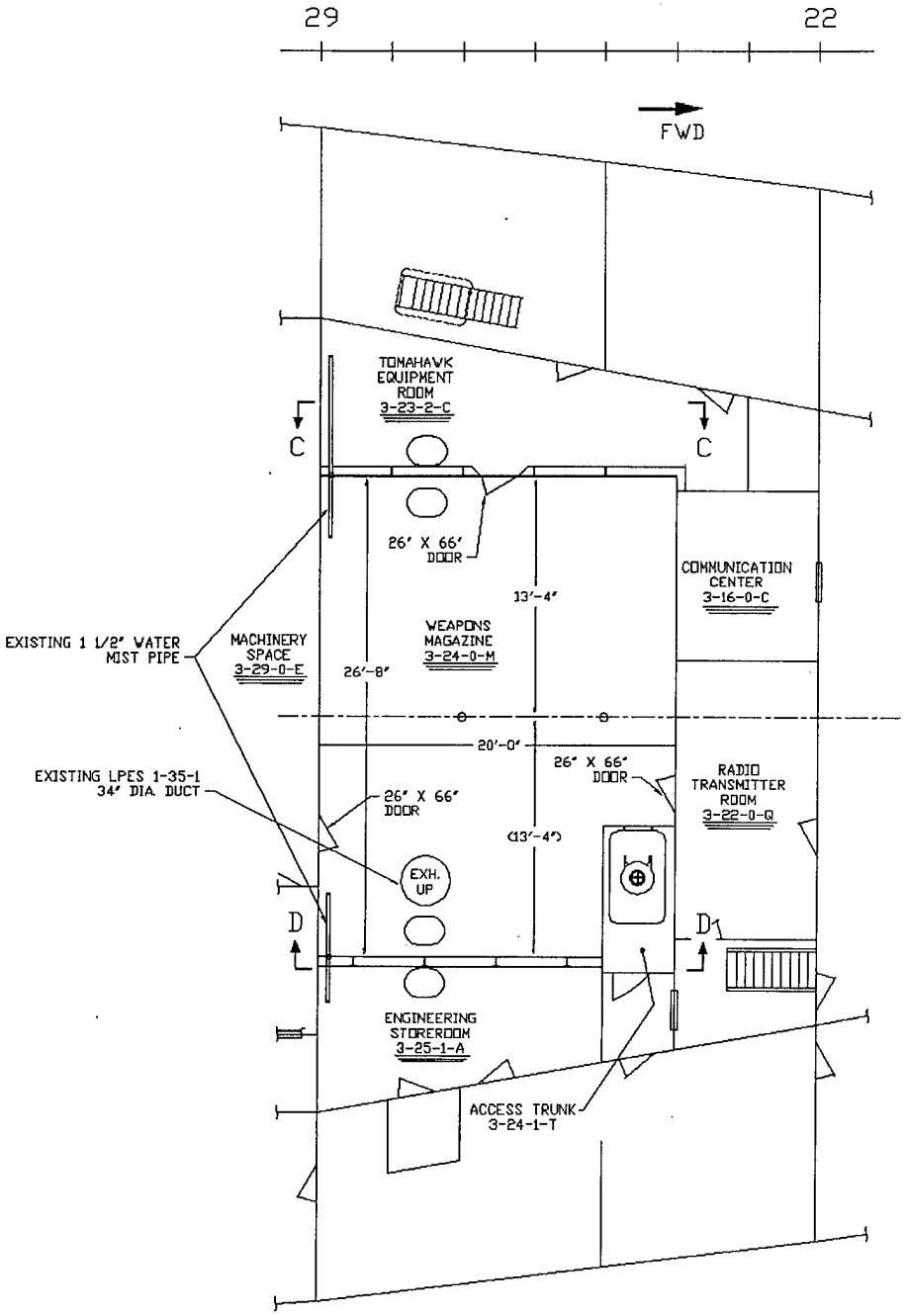

Figure 3. Weapon Magazine 3-24-0-M on 3rd Deck

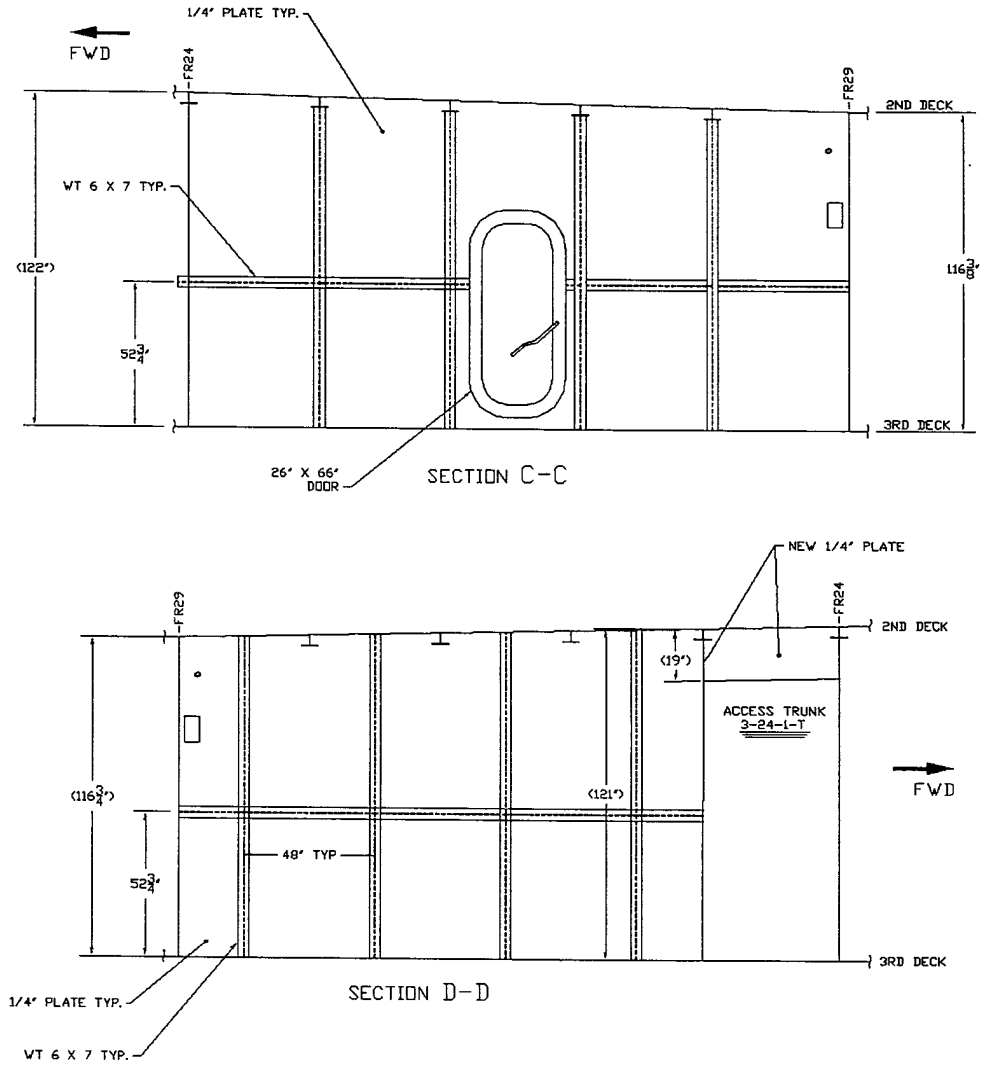

Figure 4. Weapon Magazine 3-24-0-M Exterior

At FR23 on the Main Deck of ex-SHADWELL exists a "Stepped Deck." See Section A-A of Figure 2. This feature creates an abrupt change in the profile for the overhead for Magazine 2-22-2-M. It creates an unrealistic profile. Because of the lack of realism, that portion of the overhead has been covered up with newly installed 0.64 cm (0.25 in) plate. This installation is not of a watertight nature, but it does provide a significant boundary as it pertains to this test program.

The gross volume for the medium magazine is equal to 141.9 m^3 (5,010 ft^3) as derived from the dimensions shown in Table 2.

Table 2. Dimensions of Weapon Magazine 3-24-0-M

Parameter	Dimension
Length	6.1 m (20 ft 0 in)
Width	8.1 m (26 ft 8 in)
Height	3.0 m (9 ft 8 in) FR29 3.1 m (10 ft 2 in) FR24 3.0 m (9 ft 11 in) Average
Volume	141.9 m^3 (5,010 ft^3)

The medium magazine is bordered by six different test compartments aboard ex-SHADWELL. Those being:

Communications Center 3-16-0-C (FWD)

Radio Transmitter Room 3-22-0-Q (FWD)

Access Trunk 3-24-1-T (FWD & STBD)

Engineering Storeroom 3-25-1-A (STBD)

Machinery Space 3-29-0-E (AFT)

Tomahawk Equipment Room 3-23-2-C (Port)

At FR24 on the 3rd Deck of ex-SHADWELL exists Access Trunk 3-24-1-T. See Section D-D of Figure 4. This trunk protrudes into the general area of Weapon Magazine 3-24-0-M, but the bulkheads of the trunk did not extend completely to the 2nd Deck overhead, leaving an alcove approximately 0.5 m (19 in) high. This alcove created an unrealistic void area in the overall

layout of the mock weapon magazine. The alcove has been eliminated through the installation of newly installed 0.64 cm (0.25 in) plate between the Access Trunk and the 2nd Deck.

The small and medium magazines partially border each other in the over-under orientation. The deck area of small Weapons Magazine 2-22-2-M that over laps the medium Weapon Magazine 3-24-0-M spans from FR24 to FR27 and is the full width of Magazine 2-22-2-M. See Figure 5. This area equals 13.2 m^2 (142.3 ft^2). Underneath Weapons Magazine 3-24-0-M is the aft portion of Machinery Space 4-22-0-E.

3.0 STRUCTURAL SYSTEM

Generally speaking, the area aboard ex-SHADWELL where the two mock weapon magazines reside is of lighter construction than their real counterparts on CVNX. Using nominal values, the deck thickness for CVNX ranges from 0.6 cm (0.25 in) to 1.9 cm (0.75 in) of hardened steel in the area of weapon magazines. On a similar note, the CVNX bulkhead thickness ranges from 0.6 cm (0.25 in) to 1.0 cm (0.38 in) in the areas that many magazines exist. In contrast, the ex-SHADWELL Weapon Magazine 2-22-2-M is 0.6 cm (0.25 in) thick plate on all six sides. The bulkhead, overhead, and deck stiffeners of this small magazine are WT6 X 7 structural tees. See Figure 2. Frame, or stiffener spacing is 1.2 m (4 ft).

The ex-SHADWELL Weapon Magazine 3-24-0-M is basically 0.6 cm (0.25 in) thick plate on five of the six sides. The exception is the deck plate. The ex-SHADWELL 3rd Deck plating is 1.1 cm (0.44 in) thick by design. Due to deterioration over the years of commissioned service and exposure to fire testing over recent years, it is reasonable to say that plate is slightly less. Like the small magazine on the 2nd Deck, the stiffeners for the medium magazine on the 3rd Deck are WT6 X 7 structural tees, with their spacing equal to 1.2 m (4 ft). See Figure 4.

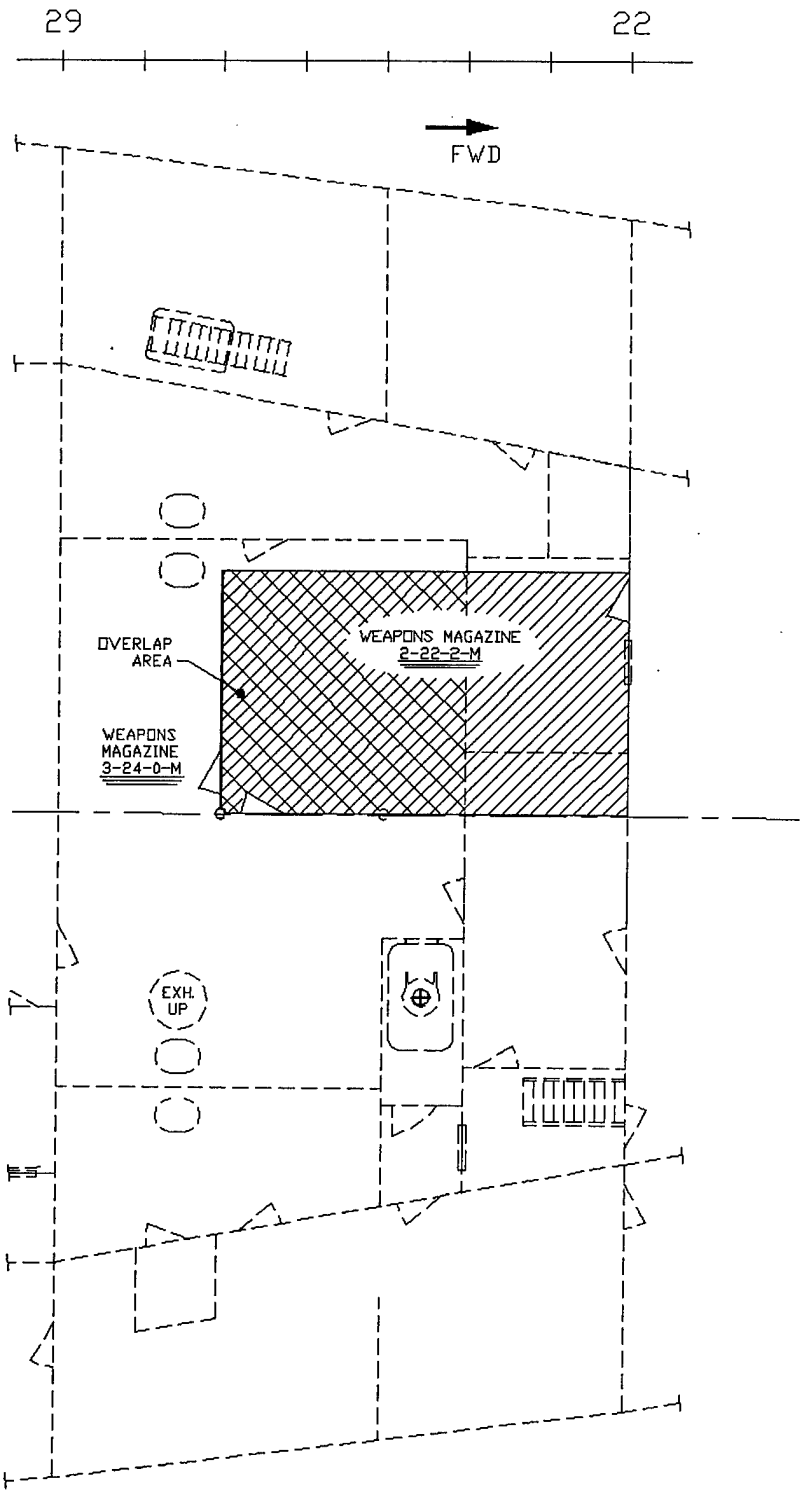

Figure 5. Weapon Magazine Overlap

The creation of the two mock weapon magazines aboard ex-SHADWELL required new installation of roughly half the total bulkheads. The remaining bulkheads were pre-existing. The new bulkheads were installed with stiffeners on the exterior of the mock magazines. Of the stiffeners on the pre-existing bulkheads, the vast majority of those were already on the exterior side of the two mock weapon magazines. With a few rare exceptions, the interior bulkhead surface areas of the two mock weapon magazines provide a smooth profile. This approach was deliberate, so any stiffener size and spacing could be mocked up in the magazine interior. The bulkhead structural integrity is maintained by the stiffeners provided on the exterior.

Review of CVN 77 drawings [2-4] indicate deck stiffeners in and around weapon magazines range from 0.3 m – 0.5 m (12 in – 18 in) in depth and are spaced 1.0 m – 1.8 m (3.3 ft – 6 ft) apart. The spacing of stiffeners on ex-SHADWELL in the vicinity of the two weapon magazines is 1.2 m (4 ft); consequently, this provides a relatively good match to the CVN 77 parameters. The depth of stiffener is not as good a match.

The existing overhead stiffeners inside the two mock magazines aboard ex-SHADWELL are WT6 X 7 structural tees that provide a depth of 15.2 cm (6 in) underneath the overhead plate. In order to provide a more realistic mock up, these stiffeners should be deeper. To accomplish this, an additional stiffener is "stacked" underneath the existing stiffener. See Figure 6. This approach provides a more realistic mock stiffener that is 0.3 m (12 in) deep.

It is reasonable to believe all the structural steel that has been added to ex-SHADWELL since it has become a research platform is mild carbon steel of ASTM A36 grade. In comparison, much of the steel in and around the weapon magazines of CVNX is likely of higher strength carbon steel. For the purposes of this program, the strength of the material is of little consequence. The thermal conductivity of the steel is essentially equal regardless of strength; therefore, one of the more important physical properties for fire dynamics is closely matched.

Inside the "Universal Weapons Magazines" of CVNX exists an overhead grid to protect light fixtures, wire ways, sprinklers, and vent ducts from potential damage that might be caused by weapon handling operations. On CVNX this overhead grid is constructed of 5.1 cm x 5.1 cm

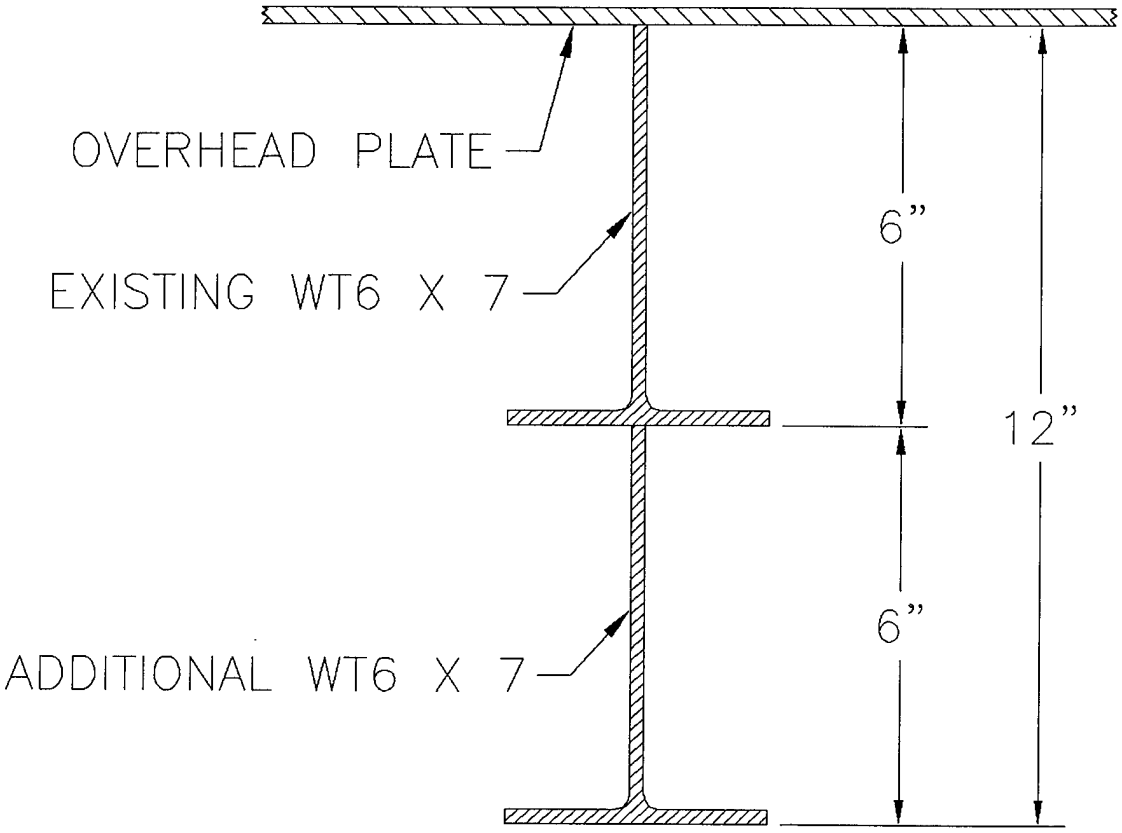

Figure 6. Mock Overhead Stiffeners

x 0.6 cm (2 in x 2 in x 0.25 in) steel tubing. The maximum spacing for the tube sections is 1.2 m x 1.2 m (4 ft x 4 ft). The grid is attached to the overhead plate and stiffeners with hangers constructed of 5.1 cm x 5.1 cm x 0.5 cm (2 in x 2in x 3/16 in) structural steel angle. A review of CVNX drawings reveal the height between the deck and the underside of the protective grid varies among magazines. For example, the height of 2.4 m (8 ft) is provided in Magazine 5-138-0-M. For Magazines 4-128-0-M and 4-138-0-M the clear height is 2.1 m (6 ft 10 in).

Aboard ex-SHADWELL, a carbon steel tube per ASTM A500 Grade B was utilized. The tube size of 5.1 cm x 5.1 cm x 0.6 cm (2 in x 2 in x 0.25 in) and the grid spacing of 1.2 m x 1.2 m (4 ft x 4 ft) will be maintained in the mock magazines. The average height above the deck for the protective grid in Weapon Magazine 2-22-2-M is 2.2 m (7 ft 1 in). The height above the deck for the grid inside Weapon Magazine is 3-24-0-M is 2.5 m (8 ft 1 in).

Installed upon the deck of all the Universal Weapon Magazines of CVNX is a system of channels [5]. This system of deck channels provides anchoring locations for the inventory of ordnance when they are placed inside the magazine.

The channel used is a standard American Steel Channel C3x6 after it has been modified. Rather than using the channel as initially rolled, it is shortened by cutting the flange down from the standard width of 4.1 cm (1.6 in) to 2.2 cm (0.88 in). Through the web of the channel, a series of 2.9 cm (1.13 in) diameter holes are provided every 15.2 cm (6 in) along the centerline of the channels. The channels are then welded to the deck plate with spacing of 0.2 m (9 in) center-to-center. After the channels are fastened to the deck, the surfaces are properly prepared and primed using MIL-P-24441/1 Formula 150. The recessed areas between the channels are then filled in with latex concrete to a nominal depth of 2.2 cm (0.88 in) to provide a smooth profile for the finished deck [6]. The latex concrete shall conform to MIL-D-21631.

A system of deck channels and associated latex concrete is planned for the Weapon Magazine 2-22-2-M. The degree of thermal conduction through the steel deck, the channels, and the latex concrete is of interest to this program. It is anticipated a thermal insult would be applied either directly or indirectly underneath the deck surface in question. See Figure 7.

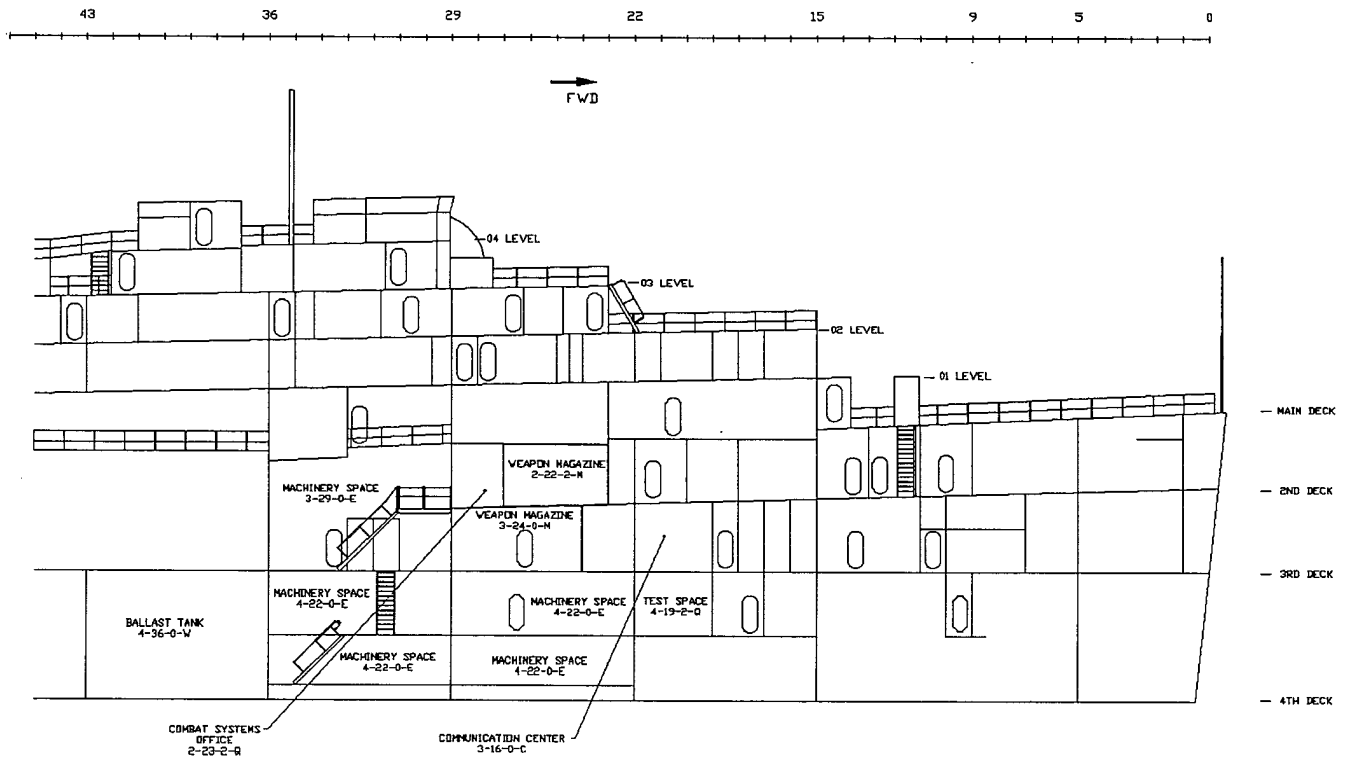

Figure 7. ex-SHADWELL Inboard Profile

4.0 INSULATION

Insulation materials approved for weapon magazines are fibrous glass board per MIL-I-742 Type I, and polyimide foam per DOD-I-24688, Type I or Type II, Class 1 [7]. Typically 2.5 cm (1 in) of insulation is required on the interior of magazines. This coverage would include bulkheads, overheads, their associated stiffeners, as well as doors. The bulkhead insulation coverage spans from the overhead down to the deck. When two magazines border each other, insulation is required between each only when one is air-conditioned and the other is not. In this instance the air-conditioned magazine is insulated on its interior side using 2.5 cm (1 in) material. When a magazine borders a horizontal weather surface, that magazine surface shall be covered with 5.0 cm (2 in) of insulation. The only instance when insulation is required on the exterior side of magazine bulkheads is when the expected temperature inside the adjacent space might exceed 41 °C (106 °F). If the expected temperature is between 41 °C and 48 °C (106 °F and 119 °F), 2.5 cm (1 in) of insulation is required. If the expected temperature is in excess of 48 °C (119 °F) 5.0 cm (2 in) of insulation is required.

Prior to installation of insulation on a typical Naval vessel, the steel bulkheads and stiffeners would be properly prepared and receive a coat of Epoxy Polyamide Primer Formula 150 per MIL-P-24441/1. The most common method of attachment for insulation for magazines includes the use of flanged annular ring Navy studs that conform to MIL-S-24149 along with aluminum Navy caps. Once attached to the bulkheads and overheads, the seams are sealed using fibrous glass lagging tape per MIL-C-20079 and lagging adhesive per MIL-A-3316. Once the insulation is installed and seams are taped, a coat of Chlorinated Alkyd White Formula 124 would be applied. Formula 124 conforms to DOD-E-24607.

It is anticipated the mock weapon magazines aboard ex-SHADWELL will be insulated as necessary to meet specified test objectives. The minimum level of thermal insulation pertaining to CVNX weapon magazines would equate to zero for the boundaries between magazines when they are not air-conditioned. This would present the worst-case scenario. Because of this potential condition, it is anticipated there will be tests performed using uninsulated bulkheads. For uninsulated surfaces, the application of Formula 150 Primer and Formula 124 topcoat as

described above would still be applicable. As test plans are developed, the possibility exists some, or all bulkhead and/or overhead surfaces could be insulated. In these instances, material and installation procedures described above will be followed to create realistic conditions.

5.0 VENTILATION

Ventilation of weapon magazines aboard CVNX can be classified as two different methods. The first is called Blow-Out Ventilation, and the second is Forced Ventilation.

Blow-Out Ventilation is used on magazines that are closed much of the time. Prior to personnel entering the magazine, the Blow-Out valve is opened and air is vented outside the ship. Typically, a 30-minute rate-of-change is satisfied for Blow-Out Ventilation. For the sake of conversion, an exchange rate of 30 minutes equates to two (2) air changes per hour (ACH). It should be noted, the Blow-Out ventilation rate could be greater than the nominal value of 2 ACH. The quantity of blow-out air required is determined by evaluating the possibilities of carbon dioxide (CO_2) build-up using the following formula:

$N = 0.0034V$ [8]

Where V = Gross volume of compartment in cubic feet (ft^3)

If the quantity of personnel in the magazine is less than N, then a 2 ACH flow rate is applicable. If the quantity of personnel in the magazine is equal to or greater than N, then a 5 ACH flow rate should be applied. It stands to reason, if a magazine is sparsely manned, or not manned at all, a low ventilation flow rate such as 2 ACH is sufficient.

Forced Ventilation is generally applicable to those magazines that have more demanding requirements regarding air contaminants, and heating and cooling loads. The air change rate for forced ventilation can be as rapid as 12 ACH [9]. The ready service and assembly areas have the most demanding requirements. This stems from the philosophy these areas are frequently manned and providing an acceptable comfort level is sought.

The planned approach for the ventilation systems serving the mock magazines aboard ex-SHADWELL will target the extreme ends of the design parameters. Furthermore, no air conditioning is planned for the ex-SHADWELL mock-ups.

The extreme ends of the design parameters include 12 ACH at the high end and zero ventilation at the low end. Future test plans will dictate specifics on a test-by-test basis. Ventilation terminals are located in a manner to create the best possible "sweep" across the magazine area. Magazine 2-22-2-M will have an exhaust terminal in the forward Starboard corner while the supply terminal is located near the aft Port corner. See Figure 8. For this mock magazine of 64.8 m^3 (2,290 ft^3) gross volume, the targeted airflow rate would be 13.0 m^3/min (458 CFM) to provide 12 ACH. Zero airflow is easily accomplished by securing the ventilation systems serving the mock magazine. If it is necessary to seal the ventilation system airtight, blank covers for the terminals will be installed for the zero ventilation scenarios.

Weapons Magazine 3-24-0-M will have an exhaust terminal in the forward Starboard corner. The supply terminal is located near the aft Port corner. See Figure 9. Since the gross volume of this magazine is 141.9 m^3 (5,010 ft^3) it is necessary to have an airflow rate of 28.4 m^3/min (1,002 CFM) to satisfy the 12 ACH requirement.

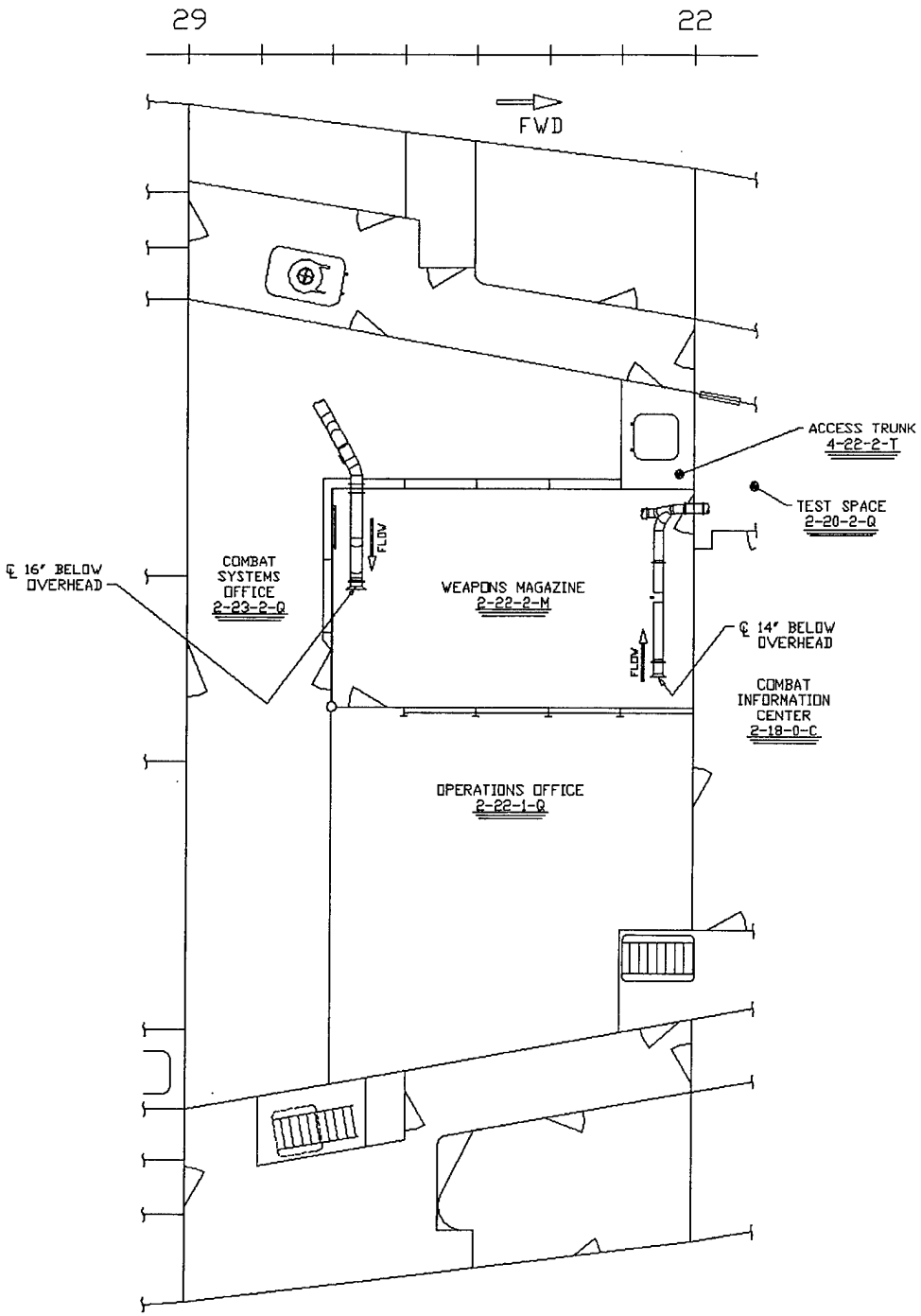

Figure 8. Ventilation Arrangement for Weapon Magazine 2-22-2-M

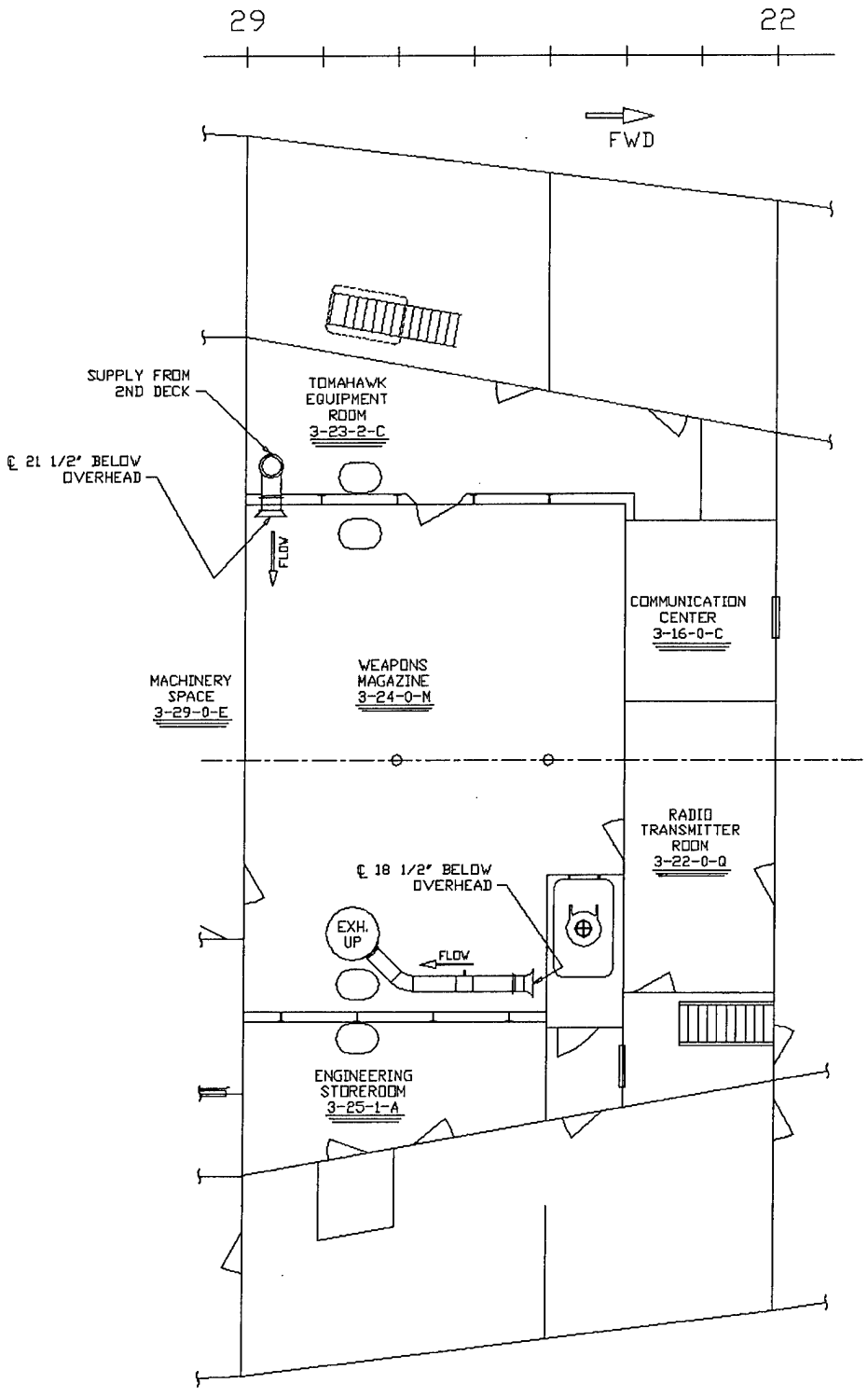

Figure 9. Ventilation Arrangement for Weapon Magazine 3-24-0-M

6.0 FIRE PROTECTION SYSTEM

The fire protection system for weapon magazines aboard CVNX has two primary objectives. The first and highest priority is to protect the magazine from fires in adjacent spaces. The second priority is to extinguish small, non-ordnance fires internal to the magazine itself. These objectives are pursued through a fire sprinkler system installed across the magazine overhead.

The application rate required of the magazine sprinkler system is 32.6 LPM/m2 (0.8 GPM/ft2)[10] using seawater as the fluid. This requirement is based on a magazine having a nominal height of 2.4 m (8 ft). For those magazines of greater height, the application rate must be increased by an additional 4.1 LPM/m2 (0.1 GPM/ft2) for every additional 0.3 m (1.0 ft) of height.

The delivery of water from the deluge type sprinkler system is achieved through one of two approved nozzles [11]. At present, the Navy approves the use of the Bete Fog Nozzle Type TF [12] as shown in Figure 10, or the GEM Type D3 Protectospray® nozzle [13] (formerly known as the Grinnell Type D3) as shown in Figure 11.

Figure 10. Bete Fog Nozzle Type TF

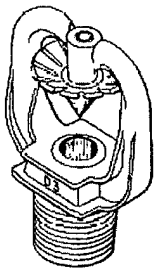

Figure 11. GEM Type D3 Nozzle

The standard Navy sprinkler system can be activated either automatically, or manually if necessary. The detection mechanism, or sensor, is the Heat Sensing Device (HSD). The HSD is a spring-loaded bellows capable of delivering a pressure pulse of air as an indication that a condition exists that warrants sprinkler system activation. See Figure 12. The HSD response is created from either a slow rise to 71.1 °C (160 °F), at which time a fusible link melts releasing the expanded bellows, or a rapid rise in temperature that simply creates the elevated pressure inside the bellows. In either case, the HSD delivers an elevated pressure pulse to a Pneumatic Released Pilot (PRP) Valve, which can reside either inside or outside the magazine. See Figure 13. The PRP Valve, in turn, triggers a sprinkler valve in the ship's firemain that permits the flow of water to the magazine sprinkler system.

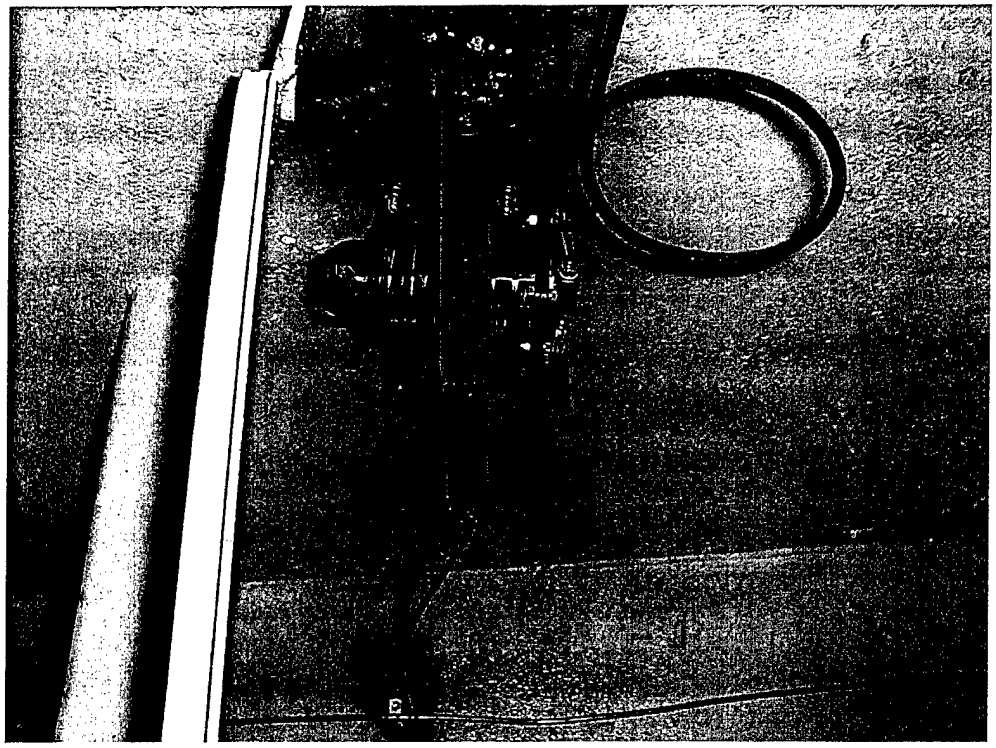

Figure 12. Heat Sensing Device Installed Near Overhead

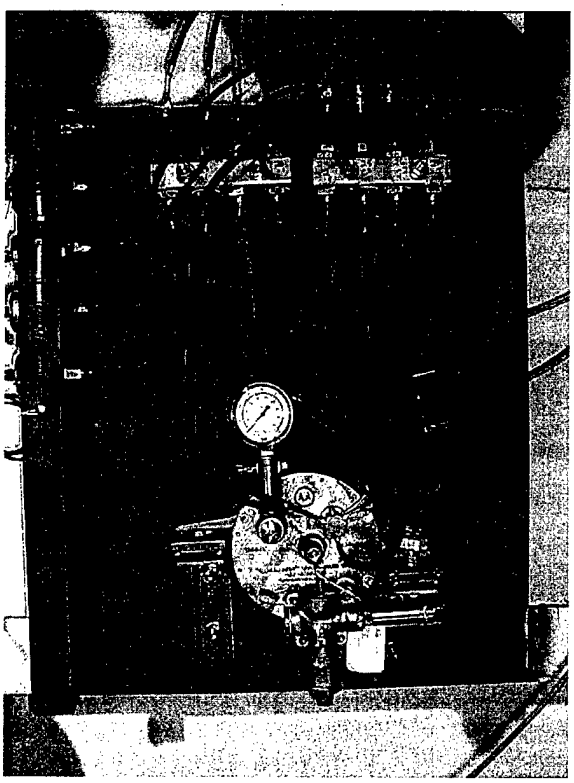

Figure 13. Pneumatic Released Pilot Valve Installation

The HSD provides the needed pressure pulse to the PRP Valve through a length of 0.3 cm (0.13 in) diameter Rockhide tubing. Along the length of the Rockhide tubing, near the PRP Valve, a vented check valve is installed to prevent the rapid pressure pulse developed from one HSD to backfill into other lengths of Rockhide tubing connected to the same PRP Valve.

The Naval Surface Warfare Center (NSWC), Philadelphia Division has been tasked with supplying the required standard hardware to properly outfit the two mock weapon magazines aboard ex-SHADWELL. The hardware provided by NSWC is listed in Table 3.

Table 3. Standard Fire Protection System Hardware

Description	Quantity
Heat Sensing Device (HSD)	12
Fusible Link	24
Vented Check Valve	12
Mounting Bracket, for Vented Check Valve	3
Test Tee	10
Street Tee	10
Pneumatic Released Pilot (PRP) Valve	2
Rock hide Tubing	300 ft
Terminal Nuts	32

In addition to the standard system hardware list, NSWC has been tasked with providing some additional hardware that goes beyond the standard Navy magazine sprinkler system. This additional hardware provided by NSWC is listed in Table 4.

Table 4. Non-Standard Fire Protection System Hardware

Description	Quantity
IC/SM-4 Alarm Panel	1
AFFF Push Button Station	2
Solenoid Operated Pilot (SOP) Valve	2
3/8" IPS Strainer	1
3/8" IPS Cutout Valve	1
3/8" IPS 90 Degree Elbow	10
Fenwal 160°F COTS Detector	13

It should be noted, beyond the standard hardware specified in Table 3, a wide array of general hardware will also be needed to create the mock sprinkler system. This general hardware would consist of items such as pipe, flanges, elbows, tees, gate valves, hangers and fasteners to name a few. The general hardware will be obtained from local suppliers.

It is anticipated the magazine sprinkler system mocked up aboard ex-SHADWELL, at a minimum, will duplicate the standard Navy magazine sprinkling system as the original baseline system. From that stage, the non-standard hardware of Table 4 will be incorporated to evaluate potentially improved detection and sprinkler control methods.

7.0 DRAINAGE

Following the use of a magazine sprinkler system inside a weapon magazine aboard CVNX, the water eventually must be drained. This is accomplished, not through a normal deck drain, but rather by a dewatering valve located near the magazine access door, or by way of the elevator door serving the magazine. In either case, the water is allowed to run down to the bottom of the access trunk, or elevator trunk, respectively. The water at the bottom of either of these trunks is then pumped over board through the use of portable pumps. In essence, the weapon magazine is a space that fills with water when the sprinkler system is activated. It fills with water until someone deliberately drains the water from the magazine.

Aboard ex-SHADWELL, a simple system of one or two deck drains from both the small and medium magazines will be implemented. This will help expedite test turn around. To accurately emulate magazine spaces that will fill as the sprinkler system is activated, the drainage system will have valves in the drain pipes so a closed system is realized during tests. Following each test, the drain valves could then be opened, allowing the water held in each mock magazine to drain out. The drain system will discharge into one of the nearby ballast tanks on ex-SHADWELL. From the ballast tank, Ship's Force will remove the water through the use of submersible pumps.

8.0 MAGAZINE STOWAGE

Protection from shock, excessive temperature, and security against movement are a few of the primary objectives of the stowage systems relative to CVNX magazines. Generally speaking, weapons aboard CVNX are placed in magazines in a palletized manner. Underneath the pallets would exist the deck channels mentioned in Section 3.0 Structural System. The deck channels provide the foundation for anchoring weapons safely. Above the deck, a variety of hardware is utilized to complete the anchoring of weapons. Portable battens and stanchions, J-hooks, and chocks are a few types of stowage hardware.

Given the environment aboard ex-SHADWELL, i.e. lacking in dynamic forces that might cause shock and potential movement of mock ordnance, many of these stowage techniques may never be implemented. Specific test plan objectives will state otherwise. On the other hand, a few specifications are very important regarding placement of mock ordnance for the tests planned aboard ex-SHADWELL. Proximity of weapons to magazine boundaries can be a very important parameter when heat transfer through those boundaries is concerned. Placement of ordnance can be as close as 5.1 cm (2 in) from the bulkhead surface and 15.2 cm (6 in) below the sprinkler nozzles of the overhead fire protection system [10]. The distance of 5.1 cm (2 in) from the bulkhead does not include the depth of stiffeners, but is the plate surface. It is anticipated these acceptable standards for ordnance placement will play a major role in testing aboard ex-SHADWELL.

9.0 ELECTRICAL

Electrical power systems pertinent to CVNX weapon magazines are considered insignificant to the list of test objectives for the mock magazines. Consequently, little or nothing is mocked up for electrical power systems.

In contrast, emulating the proper levels of illumination has been pursued. The amount of illumination for weapon magazines aboard CVNX range from 7.0 to 28.0 Foot-Candles per square foot, depending upon what type magazine is considered [14]. Ready Service magazines and handling and build-up areas (approximately 55.7 m^2 (600 ft^2)) in front of weapon elevator openings receive the highest degree of illumination, or the 28.0 Foot-Candles per square foot. Alternate nuclear weapon magazines, weapon elevator trunks, and magazines outfitted with bins and racks receive 14.0 Foot-Candles per square foot. Lastly, most other remaining magazines receive 7.0 Foot-Candles per square foot of illumination.

The lighting installed in the two mock magazines aboard ex-SHADWELL will be patterned after the approximate average of 28.0 and 14.0 Foot-Candles per square foot. The standard navy 40-watt, 120-volt fluorescent light fixture per MI16377/11 is installed. The fixtures are located in each magazine approximately as shown in Figure 14, with the distance

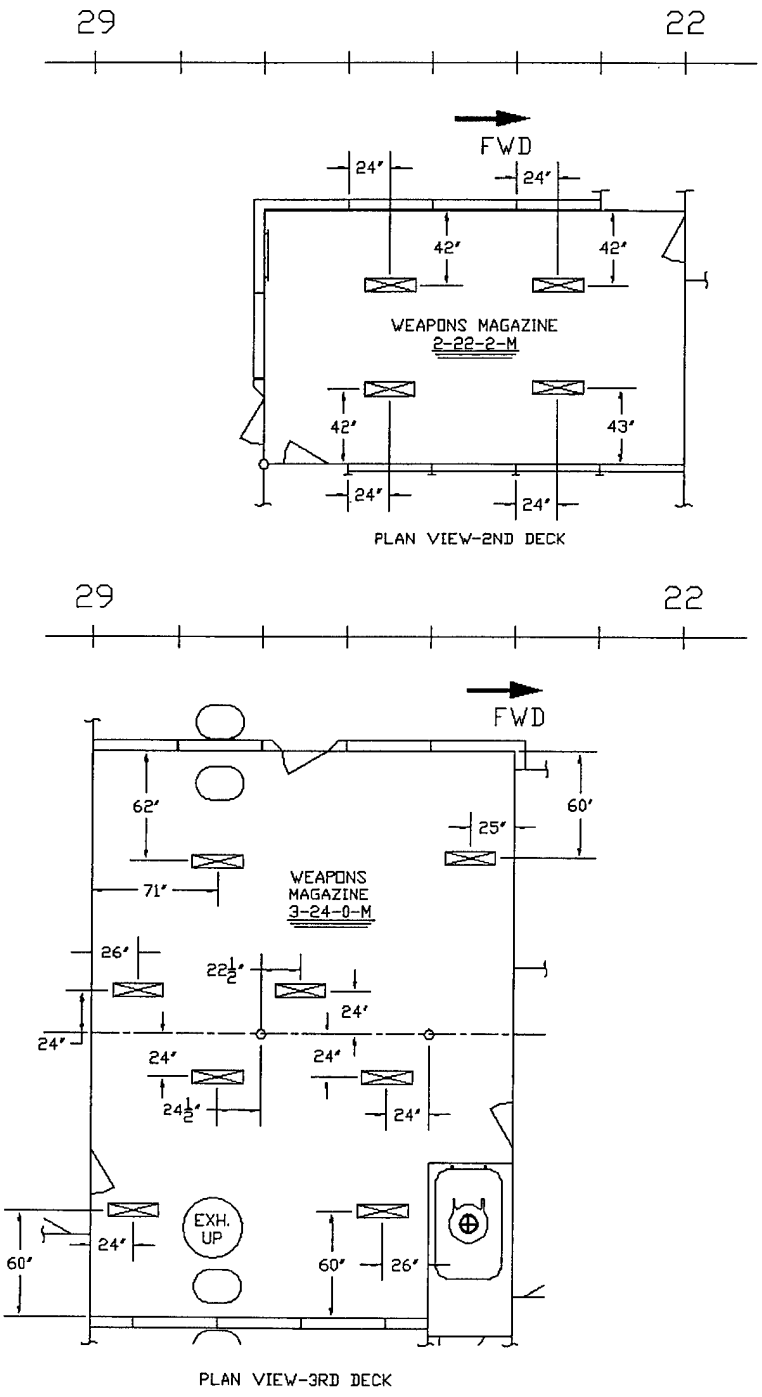

Figure 14. Mock Weapon Magazine Lighting Arrangements

from the overhead to the lower side of the fixture equal to 0.4 m (16 in). These arrangements produce an approximate illumination of 20.7 Foot-Candles per square foot for Magazine 2-22-2-M and 22.7 Foot-Candles per square foot for Magazine 3-24-0-M. These values were computed for a horizontal plane 0.8 m (30 in) above the deck surface, which is the same requirement established for CVNX [9].

10.0 CONCLUSIONS

Two mock weapon magazines are under development aboard ex-SHADWELL to support Live Fire Test & Evaluation assessments as they pertain to CVNX. Details of structural, mechanical, and electrical systems have been discussed and the various hardware items identified. This collection of hardware, or outfitting, has been compiled into Table 5 below as a summary.

Table 5. Summary of Outfitting Hardware

Item Description	Specification	National Stock Number
Structural Outfitting		
Plate, 0.6 cm (1/4") thick	ASTM A36	
Channel, C3 X 6	ASTM A36	
Tee, WT6 X 7	ASTM A36	
Tube, 5.1 cm x 5.1 cm x 0.6 cm (2" x 2" x 1/4")	ASTM A500, Grade B	
Deck Covering, Latex Concrete	MIL-D-21631	
Insulation Outfitting		
Adhesive, Lagging	MIL-A-3316	
Cap, Aluminum Navy		
Insulation, Fibrous Glass Board	MIL-I-742, Type I	
Insulation, Polyimide Foam	DOD-I-24688, Type I or II, Class 1	
Primer, Epoxy Polyamide, Formula 150	MIL-P-24441/1	8010-00-437-6757
Stud, Flanged Annular Ring Navy, 4.4 cm Long x 0.5 cm Dia. (1-3/4" x 3/16")	MIL-S-24149	
Stud, Flanged Annular Ring Navy, 1.9 cm Long x 0.5 cm Dia. (3/4" x 3/16")	MIL-S-24149	
Tape, Fibrous Glass Lagging	MIL-C-20079	
Topcoat, Chlorinated Alkyd White, Formula 124	DOD-E-24607	8010-00-577-4789

Table 5. Summary of Outfitting Hardware (con't)

Item Description	Specification	National Stock Number
Fire Protection Outfitting		
0.9 cm (3/8") IPS 90 Degree Elbow		4820-00-483-0675
0.9 cm (3/8") IPS Cutout Valve		4730-01-384-0915
0.9 cm (3/8") IPS Strainer		
AFFF Push Button Station		
Fenwal 160 °F COTS Detector		
Fusible Link		
Heat Sensing Device (HSD)		4210-00-111-7020
IC/SM-4 Alarm Panel		
Mounting Bracket, for Vented Check Valve		
Nozzle, Bete Fog	Type TF	
Nozzle, GEM	Type D3	
Street Tee		
Terminal Nuts		
Test Tee		
Tubing, Rockhide, 1/8" O.D.		4710-00-039-5702
Valve, Pneumatic Released Pilot (PRP)		4210-00-575-9297
Valve, Solenoid Operated Pilot (SOP)		
Valve, Vented Check		4820-00-747-9704
Electrical Outfitting		
Light Fixture, Fluorescent	MIL-F-16377/11	6210-00-215-6355

11.0 REFERENCES

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